MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

EEM1016 – ENGINEERING MATHEMATICS I

(All sections / Groups)

07 OCTOBER 2016
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question paper consists of 4 pages (including cover page) with 5 Questions only.

2. Attempt ALL questions. The distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

(a) Evaluate the following limits:

(i) $\lim_{x\to\infty}\dfrac{2+9x^3}{(1+x)(3+x^2)}$ [2 marks]

(ii) $\lim_{x\to 2}\dfrac{2-\sqrt{8-x^2}}{x-2}$ [2 marks]

(b) Differentiate the following functions with respect to x:

(i) $y=\tan\left(\dfrac{1-x}{1+x}\right)$ [2 marks]

(ii) $xy=\ln(\cos x+\sin y)$ [2 marks]

(c) Consider the function $f(x)=x^3-8x^2+16x$. Determine the extremum point (s), if any.

[5 marks]

(d) Find $\int\dfrac{e^{2x}}{1-e^{2x}}dx$. [3 marks]

(e) Let $f(x)=\int_0^{\frac{1}{x^2}}\sqrt{1+t^3}\,dt$. Use the Second Fundamental Theorem of Calculus to find

(i) $f'(x)$

(ii) $f'(1)$

[4 marks]

[Hints: $\dfrac{d}{dx}\int_a^{g(x)}f(t)dt=f[g(x)]\dfrac{dg}{dx}$**]**

Continued...

Question 2

(a) Test the series $\sum_{n=1}^{\infty} \frac{1}{6^n + 9}$ for convergence or divergence by using the Direct Comparison Test.

[3 marks]

(b) Test the series $\sum_{n=1}^{\infty} (-1)^n \frac{5^n}{3n^2 - 2}$ for convergence or divergence by using the Alternating Series Test.

[3 marks]

(c) Test the series $1 + \frac{1}{2^9} + \frac{1}{3^9} + \ldots + \frac{1}{n^9} + \ldots$ for convergence or divergence by using the p-Series Test.

[3 marks]

(d) Find the interval of convergence of the power series $\sum_{n=1}^{\infty} \frac{1}{\sqrt{n}} x^n$.

[11 marks]

Question 3

(a) Let $f(x, y) = x^3 - y^3 - 12x + 16y + 5$.

(i) Find all the critical points of $f(x, y)$.

[4 marks]

(ii) Use the second derivative test to determine the nature (local minimum or local maximum) of each such point.

[6 marks]

(b) Using Lagrange Multipliers, maximize $36 - x^2 - y^2$ subject to the constraint $x + 7y = 25$.

[10 marks]

Continued...

Question 4

(a) Given that $\boldsymbol{a} = 2\boldsymbol{i} + \boldsymbol{j} + \boldsymbol{k}$, $\boldsymbol{b} = \boldsymbol{i} - 2\boldsymbol{j} + 2\boldsymbol{k}$ and $\boldsymbol{c} = 3\boldsymbol{i} - 4\boldsymbol{j} + 2\boldsymbol{k}$. Find the projection of $\boldsymbol{a} + \boldsymbol{c}$ in the direction of $\boldsymbol{b}$.

[3 marks]

(b) Find the equation of the plane passing through three points, **a** = (1,2,3), **b** = (2,4,5) and **c** = (4, 5, 6).

[6 marks]

(c) Given that $z^4 = 3 - 4i$. Obtain the four solutions of z and giving your answer to three decimal places.

[8 marks]

(d) Evaluate ln(-3 + 4*i*) in the Cartesian form of $x + iy$. Display your answer to three decimal places.

[3 marks]

Question 5

A periodic waveform of the function $f(x)$ is shown in Figure Q5.

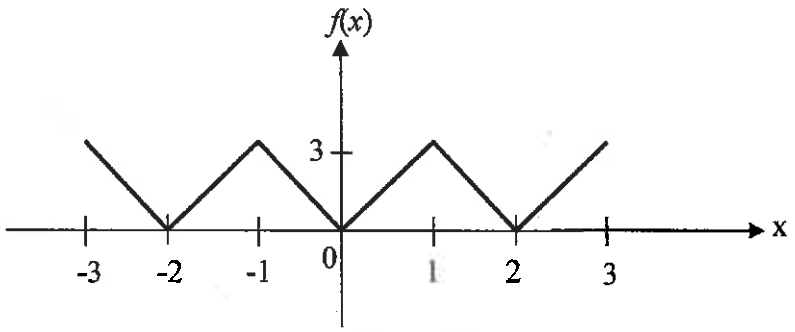

Figure Q5

a) Identify the period of the function $f(x)$. [1 mark]

b) Define the function $f(x)$ from the interval (-1,1). [3 marks]

c) Is $f(x)$ an **even** function, odd function, or neither? Justify your answer. [2 marks]

d) Find the Fourier series expansion of the function $f(x)$. [12 marks]

e) Prove that $\dfrac{\pi^2}{8} = \sum_{n=1}^{\infty} \dfrac{1}{(2n-1)^2}$ [2 marks]

End of Paper.